2C09: *A-PRIORI* ANALYSIS OF CONDITIONAL MOMENT CLOSURE MODELING OF A TEMPORAL ETHYLENE JET FLAME WITH SOOT FORMATION USING DIRECT NUMERICAL SIMULATION.

David O. Lignell, University of Utah, USA
John C. Hewson[2], Jacqueline H. Chen, Sandia National Laboratories, USA

Comment by Hossam El-Asrag, Center for Turbulence Research, USA
hossam@stanford.edu

Regarding your final comments that thermophoresis forces are negligible. I wonder if you think this conclusion is more related to the mixing layer problem, since the temperature gradients in this case are changing with time.

Reply by David Lignell
david@crsim.utah.edu

The thermophoretic velocity was found to be small compared to the mixture fraction isocontour velocity in the two-dimensional decaying turbulence simulation (reference 11 in the paper), and also in a one dimensional unstrained diffusion flame study (unpublished). In the present, turbulent planar jet, while temperature gradients are changing in time (becoming smaller) the mixture fraction gradients, which are related to temperature gradients and drive the mixture fraction isocontour velocity, are also becoming smaller as the jet decays. Hence, dominance of mixture fraction transport over thermophoretic transport does not appear to be an artifact of the flow configuration.

Comment by Garcia-Ybarra, UNED, Spain
pgybarra@ccia.uned.es

The analysis you have shown for the transport of soot particles in turbulent flames accounts for the thermophoretical drift, which may be operative for ultrafine particles (the submicronic range). However for the coagulated soot particles that reach to the micronic range (fine particles) and larger, inertial effects (Stokes number effects) coupled to inhomogeneous turbulence leads to the so-called turbophoretical drift (flux of particles down the gradient of turbulence intensity). Could you comment about the relevance of this transport mechanism in the kind of flames you are considering?

Reply by David Lignell
david@crsim.utah.edu

The timescales present in the simulation do not allow substantial particle agglomeration and particle sizes remain in the submicron regime, on the order of ten nanometers. Estimates of Stokes numbers for the simulation are much smaller than unity and the so called turbophoretic drift will not be significant. It is true that in cases for which large soot particles are present, particle inertial forces should be accounted for.